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West Point, New York 10996**

Pro Forma: A Meta-Model for Force Structure Costing

Major James P. Cummings

**OPERATIONS RESEARCH CENTER
TECHNICAL REPORT NO. FY92/90-2**

8 June 1992

The Operations Research Center is supported by the Assistant Secretary of the Army for Financial Management.

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A Meta-Model for
Force Structure Costing**

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A TECHNICAL REPORT
OF THE
OPERATIONS RESEARCH CENTER
UNITED STATES MILITARY ACADEMY

Directed by
Lieutenant Colonel James E. Armstrong, Jr. Ph.D.
Director, Operations Research Center

Approved by
Colonel James L. Kays, Ph.D.
Professor and Head
Department of Systems Engineering

8 June 1992

This project is sponsored by the Director of the Army Budget and the Army Budget Office,
Headquarters, Department of the Army.

The Operations Research Center is supported by the Assistant Secretary of the Army for Financial Management.

Vita

Major James P. Cummings was born in Pittsburgh, Pennsylvania, in 1958. He graduated with honors from the United States Military Academy at West Point in 1980. After seven years in various Field Artillery Assignments in Texas and Germany, he received his MS in Operations Research from the Georgia Institute of Technology in preparation for teaching undergraduate mathematics in the Department of Mathematical Sciences, USMA. After teaching courses in Calculus, Differential Equations, and Probability and Statistics, he was selected for a one year position as an analyst for the Operations Research Center of Excellence, United States Military Academy.

Acknowledgments

This project was sponsored by Brigadier General Josue Robles, Jr., Director of the Army Budget while he was the Director of Operations and Supply. The research was supported by the Assistant Secretary of the Army for Financial Management.

Brigadier General Robert Howard, former Director of Operations and Supply, Army Budget Office, currently Director of Resource Management at Army Material Command, was an early sponsor of the Operations Research Center. He opened doors and fostered a spirit of cooperation and understanding.

Colonel Frank R. Giordano, Professor and Head of the Department of Mathematical Sciences, gave me the opportunity to conduct this research in lieu of teaching for the year. He has consistently pushed instructors to broaden their horizons and improve their technical skills.

Mr. Frank Distasio, Director, Program Management and Systems Development Agency, Department of the Army, provided comments and suggested further avenues to pursue in the coming year.

Major Thomas R. Roberts, Army Budget Office, kept me focused on the user's aspect of the project and provided guidance and explanation of the Army budget process. He took time out of his busy schedule to answer some of the most basic of questions on the budget and how to access and query the financial database.

Major Walter Lincoln, Financial Analysis, Deputy Assistant Secretary for Future Policy and Business Practices, Assistant Secretary of the Army for Financial Management, for his help in formulating this project and nurturing its development in a quiet but very effective way.

Mr. Robert Suchan, Costing and Economic Analysis Center, Department of the Army, graciously provided me with copies of the Army's different budgetary models and was not bothered by the fact that an outsider was trying to understand and use budgetary models for other than their intended purpose.

Colonel James L. Kays, Professor and Head of the Department of Systems Engineering, and Major James E. Armstrong, Permanent Associate Professor in the Department of Systems Engineering, and Director of the Operations Research Center, USMA accepted me into their fold and provided me with guidance and expertise in conducting and presenting the analysis. They have reviewed my progress and kept me focused on the task at hand. Further, they provided me with the freedom to pursue this project as I saw fit, giving guidance only when asked or when it was obvious that I was straying from the goal.

Captain Peter Courtois, fellow analyst at the Operations Research Center, did the invaluable work of establishing the foundation of the problem and making contacts with people throughout the Pentagon. He also provided the institutional memory for this project as everyone that he had worked with in the Budget Office had moved on before I took on the project.

Finally, I would like to thank my wife, Maja, and children, Chris and Nadine, for their patience and understanding.

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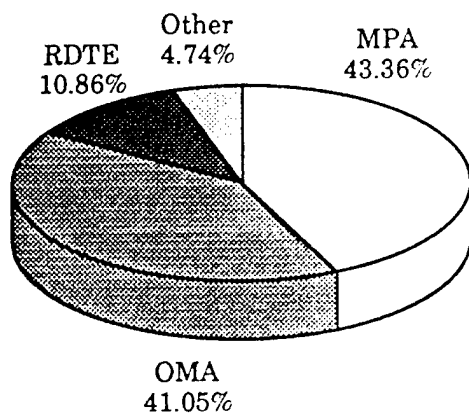
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Executive Summary

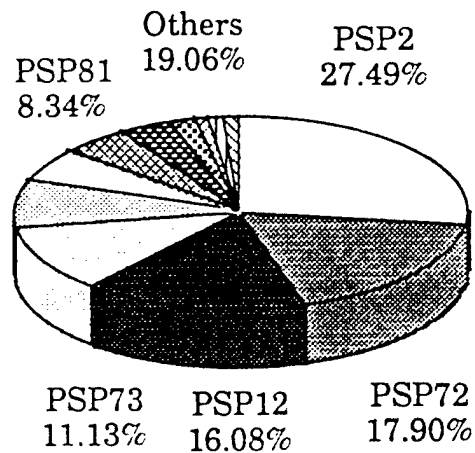
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Early efforts at creating this model concentrated on gathering data for each post and PSP for the past ten years and building a set of regression equations to do the estimates. This proved to be complex, not only because of the size of the problem, but because the definitions of each PSP had changed over the years and it was impossible to normalize expenses into today's terms. The OR Center, with the approval of ABO, shifted the focus to developing a prototype and improving the level of detail in future editions. The ultimate goal of this project is to integrate output from the Army's various costing models into a budgeting tool. The prototype uses cost factors until model results can be included.



Composition of Army Budget by
Appropriation



Composition of OMA Expenditures by
Primary Sub-Program

The prototype concentrates on unit training (P2) and facilities' maintenance (P12), the two largest components of the OMA budget, and the Major Commands (MACOMs) that spend most of this money, Forces Command, US Army, Europe, Southern Command, Pacific

Command, and the Eighth Army in Korea. Cost factors for each PSP and geographic area are based on a three year moving average, adjusted for inflation and Operation Desert Storm. Savings are computed by comparing a proposed force structure to that contained in the President's budget and multiplying the differences by the appropriate cost factors. This method of estimating expenses was accurate to within five per cent of the actual FY91 expenditures for these MACOMs. Output from an existing Army model, The Army Force Costing System, was not as precise, overestimating P12 expenditures by 80% and underestimating P2 expenses by 20%. This justifies continued use of cost factors until appropriate model results are obtained.

Pro Forma provides ABO analysts with a comprehensive tool to assist them in the performance of their job. It is a fast, flexible, easy to use system that provides an accurate estimate of expenditures for a given plan in minutes.

1. Introduction

The Defense budget process spans an eight-year horizon. The current year is the Execution Year. The next year is the Budgeting Year, and the subsequent 6 years are the POM (Program Objective Memorandum) Years. While it is possible to make changes in the Execution and Budget Years, this is not done routinely. Changes in these two years cause turmoil throughout the command structure as needs are re-prioritized and careful plans are scrapped. Changes in these two years are made only in times of emergency. Major changes in Army structure and missions are made in the POM years and beyond. This allows leaders to plan the transition from the current to the end state. This project concerns itself with primarily the POM years, currently 1994 to 1999.

1.1. Army Budget Overview

The Defense budget is formulated into eleven different programs (Table 1-1). Each of these programs is further divided into sub-programs, called Primary Sub-Programs (PSPs). Appropriations are allocated among these PSPs. While there are many appropriations' categories, the major ones are listed in Table 1-2.

Program 1	Strategic Forces
Program 2	General Purpose Forces
Program 3	Intelligence and Communication
Program 4	Air/Sea lift
Program 5	Guard and Reserve Forces
Program 6	Research and Development
Program 7	Central Supply and Maintenance
Program 8	Training, Medical, Other
Program 9	Administration and Associate Activities
Program 10	Support of Other Nations

Table 1-1. Defense Programs

MPA	Military Personnel, Army
OMA	Operations & Maintenance, Army
RDTE	Research, Development, Testing and Evaluation
MCA	Military Construction, Army
AFH	Army Family Housing
ASF	Army Stock Fund

Table 1-2. Major Army Appropriations

This paper will concentrate on the active forces and explore the National Guard and Reserves at a later date. Of the various appropriations, Military Personnel, Army (MPA) and Operation and Maintenance, Army (OMA), account for approximately 84% of the budget (Figure 1-1). Research, Development, Testing and Evaluation (RDTE) accounts for

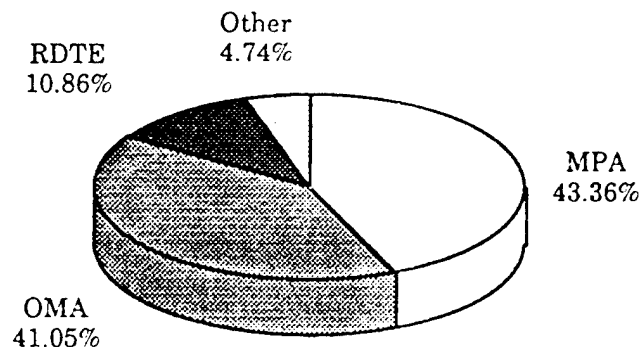


Figure 1-1. Percent Army Budget by Appropriation. This figure shows the average amount spent by appropriation for Fiscal Years 1988 through 1990. The average Army budget for these items was \$63.1 billion in 1991 dollars, not including National Guard and Army Reserve expenditures.

10% of the budget with the remainder being apportioned among the remaining appropriations.

The size of the MPA budget is generally proportional to the size of the Army, given a structure for the percentage of personnel in each pay grade. The relationship of the OMA budget, however, is not necessarily as clear. OMA dollars are accounted for in several PSPs which track the money that the Army uses in its day-to-day operations. (Table 1-3)

PSP	Nomenclature	Example
P2	Mission	Training and training related expenses
P10	Support of Other Nations	US contributions to NATO or the UN forces in Korea
P12	BASOPS	Expenditures for facilities maintenance
P38	Intelligence	Intelligence and cryptologic activities
P39	Communications	
P72	Supply	Transportation expenses and miscellaneous supplies
P73	Maintenance	Depot level maintenance of equipment
P81	Training	Training expenses through Advanced Individual Training and for selected DA schools
P87	Other	Miscellaneous personnel expenses
P95	Administration	Public affairs expenses and those pertaining to the printing of forms and publications

Table 1-3. Primary Sub-Programs for the OMA budget and a brief description. P12, BASOPS, is a dummy account. Expenditures in this PSP are actually charged against the main account of the spending activity. For example, P12 expenditures are taken from a tactical unit's P2 account and from a training activity's P81 account.

Most of the money, about 30%, provides mission-oriented training of tactical units. General supplies, facilities maintenance, depot-level maintenance of equipment, and individual training get 10 - 15 % each and the remainder of the funds are distributed among the remaining programs. (Figure 1-2)

The sponsor of this project, the Operations Section of the Army Budget Office (ABO), consists of seven military comptrollers and six civilian budget analysts. Their primary job is to keep track of current expenditures. On demand, they answer budget questions for the Army Staff, normally reacting to short suspenses, 48 hours or less. Although assignment to ABO for Army personnel is normally two years in length, it is common for them to spend only one year in the office, making the effects of personnel turnover even more pronounced. Previous attempts to automate OMA cost analysis were not widely used owing to the relatively steep learning curve of the software and the short suspense environment prevalent in the office.

As a result of these factors, most requests for information were answered using rudimentary calculations based on Army-wide cost factors. These replies were acceptable to planners in the early stages of the Army draw-down, but became inadequate as planning progressed. It was recognized that a need existed to satisfy these requests within the ABO's operating constraints, short suspenses and personnel turbulence.

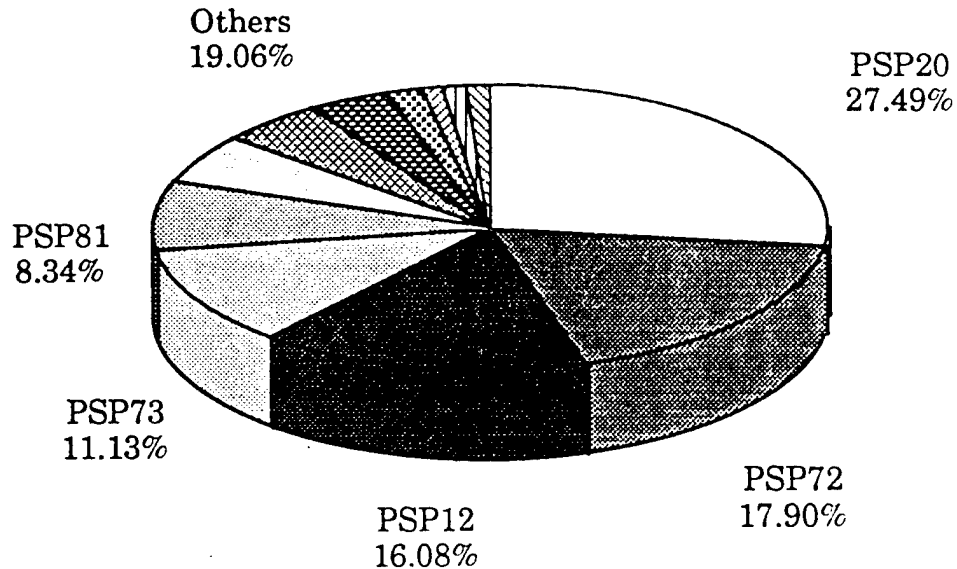


Figure 1-2. Allocation of dollars among OMA PSPs using the average data from FYs 88 - 90, adjusted for inflation.

1.2. Background

This section contains a synopsis of the events pertaining to this project through September 1991. The Operations Research Center at USMA was tasked with providing a method of estimating OMA expenditures in the wake of a declining force structure in the summer of 1990 by BG Josue Robles, then the Director of Operations and Supply, Army Budget Office. Initially, the Operations Research Center pursued a bottom-up approach, that is, the analyst set about determining the relationship among force size, location, and PSP of OMA dollar expenditure. The end result of this would be a series of regression equations quantifying these relationships into a bundle of equations which could then be used to estimate future expenses.

This approach encountered two difficulties. First, it was not feasible to normalize the OMA expenditures because of the constant change in the definitions of the PSPs. For example, one need only look at depot-level maintenance of unit equipment. In the past, the Army Material Command (AMC) paid for all such maintenance out of P73 (Maintenance) funds. This encouraged units to send equipment to higher echelons for repair as there was economic incentive to do so. In an effort to control costs and encourage repair of items as far forward as possible, it was decided to change the accounting of this cost from P73 to P2 (Mission) funds. This meant that the owning unit paid for all types of maintenance on its equipment.

Similar redefinitions occur every year. Sometimes, the money merely shifts from one sub-account to another within the same PSP. At other times, it changes from one PSP to another, as above. It even shifts from OMA to one of the other appropriations. The sheer magnitude of the effort required to normalize OMA funds to account for fluid accounting classifications was daunting. However, no summary was available on a year-to-year basis to make the task manageable from an analytic point of view.

Second, the force structure over the time of concern, 1981-1991, was relatively stable. Although data analysis could provide trends in spending, it could not predict the effects of changing the force structure.

During the course of the research for the first part of the project, the Operations Research Center analysts visited many different Army agencies while trying to determine the best way to approach the problem. It was discovered that each agency had a model of its own functional area of expenditures and much energy was put into finding and correlating the various models. Eventually, it was determined that the Program Management and Systems Development Agency, PMSDA, had compiled a listing of existing models and was even doing some rudimentary work on model integration. See Appendix A for a listing of available models and comments as to their applications.

The original intent behind our efforts was to integrate the appropriate models so that the user could access each in its original form. Further investigation revealed that this would be too cumbersome for several reasons.

First, this approach would make it mandatory that the user had access to many of the Army's databases. This is not always possible. Second, while most of the models listed in Appendix A are based either on dBase IV or Lotus 123, integrating these common programs, as well as several written in C, would be unwieldy. Third, existing models are storage intensive. The Non-Tactical Medical Support Model alone requires six megabytes of hard disk space. While this is not unreasonable for an analyst who works only with this model, it is unreasonable to expect analysts working with many models to have a hard drive dedicated to storing them. Fourth, most of the models are designed to answer very specific questions and do not provide the level of information required by the Budget Office. Finally, the overhead required to learn all of the different models is overwhelming.

To overcome these problems, the ABO and the Operations Research Center developed "Pro Forma" using a Meta- Model, or a model of models, concept.

1.3. The Meta-Model Concept

This concept centers on providing the Army Budget Office with the results of verified and validated costing models in one easy-to-use convenient package. This concept facilitates the quick "What if . . .?" drills required by the ABO. See Figure 1-3.

Compiling the results of existing Army models serves the following purposes:

1. Users will be able to take advantage of the strengths of each model without having to know how each operates.
2. Users will only have one interface to deal with when addressing budgeting questions.
3. The compiled model will run much quicker than if each individual model were called.
4. The compiled spreadsheet will be easy to update as models are created and improved.
5. Model output will be compared against historical data before it is added to the meta-model. Obvious anomalies will be identified and the responsible agency will be notified.

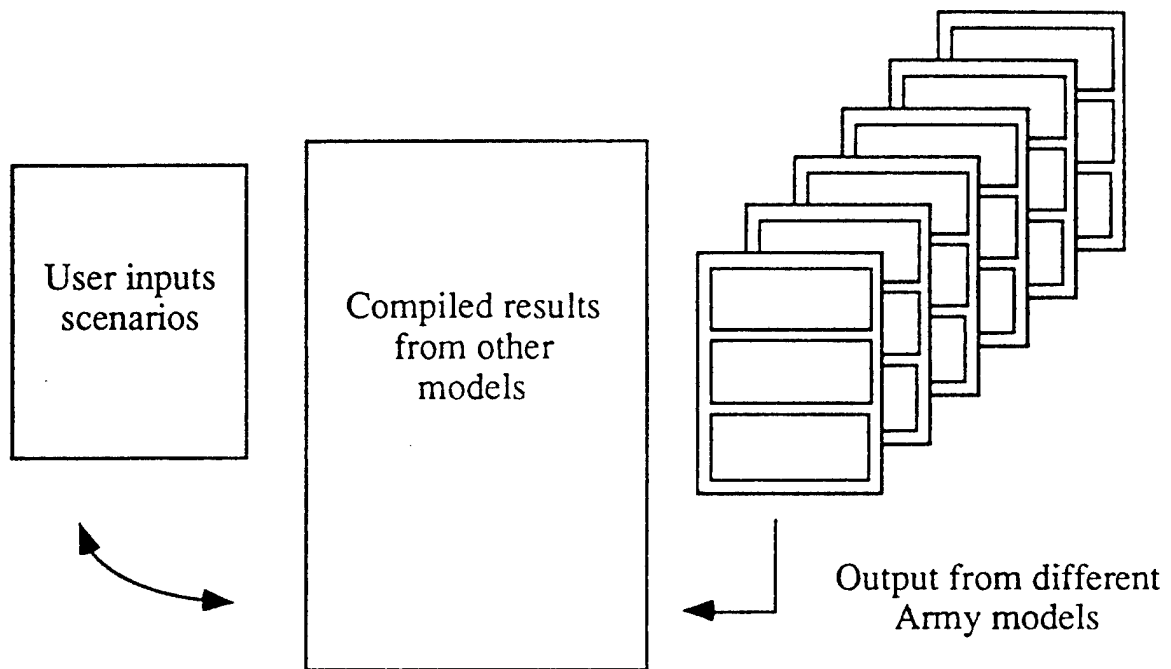


Figure 1-3. The Meta-Model Concept. Existing Army models, depicted on the right, are run at feasible troop strengths for different geographic areas. The results of these runs are put into a spreadsheet, center, which is accessed by a series of dialog boxes, shown here as the User Interface, left.

Currently, Pro Forma, a business term that describes the process of creating a budget based on current expenditures, is implemented using improved analytical cost factors until valid results from verified costing models are available.

2. Meta-Model Prototype, Pro Forma

The Army Budget Office identified the focus of this study to be the P2 (Mission) commands, FORSCOM, USAREUR, 8th Army, PACOM, and SOUTHCOM. P2 is the largest of the OMA sub-accounts (Figure 1-2) and these commands account for most of the P2 funds spent in a year. Additionally, they also account for much of the P12 (BASOPS) account. It was thought that any model that accounted for these accounts and commands would be sufficient for the ABO's purposes, at least in the near term.

2.1. Guidance from the Army Budget Office

Additionally, the ABO wanted the final product to compensate for personnel turbulence and its short suspense operating environment. The ultimate goal of the project is a user-friendly "what if?" tool that can be used by a computer novice. This would enable the Meta-Model to be used not only in the budget office but in other offices in the Army Staff.

2.2. Pro Forma Overview

The information requested from the user is designed to mimic the process that analysts follow when costing the force. (Figure 2-1) Users proceed using a series of mouse clicks on the appropriate options.

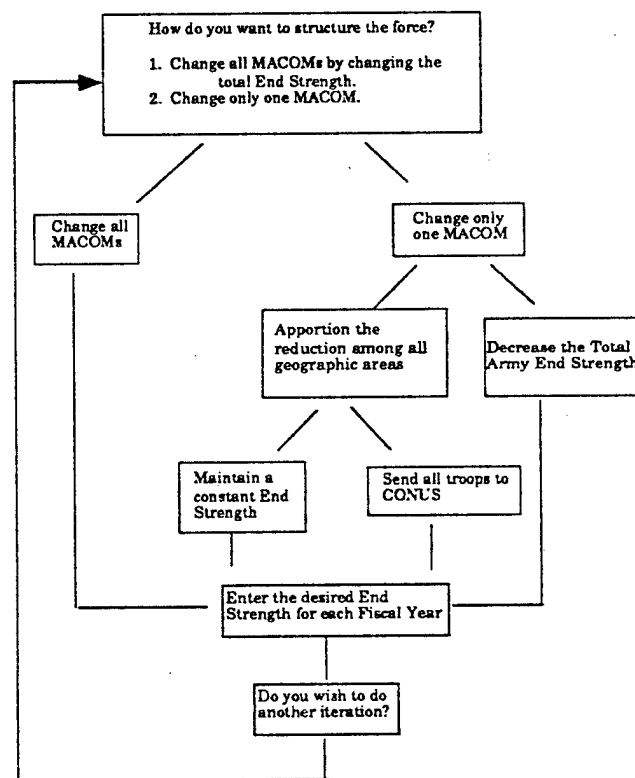


Figure 2-1. Information flow of the force structure costing Meta-Model. Users are presented with a series of questions which determine the desired outcome of the model run.

The Pro Forma spreadsheet is divided into three sections; the information, personnel, and savings sections (Figure 2-2).

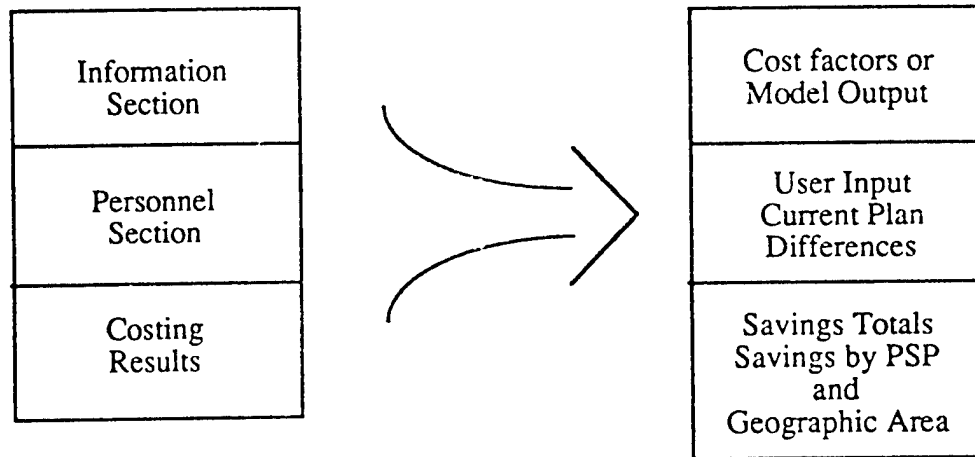


Figure 2-2. Pro Forma Spreadsheet Layout

The information section contains cost factors by PSP and geographic area and the savings drag for different types of costs. It can also include results from approved costing models as they become available. The personnel section is divided into three parts; the user input, the current plan as defined in the President's Budget, and the differences between the two. As the budget office is interested in additional savings generated by force changes, all savings are derived from the difference between the current plan and the analyst's option. The analyst need only input one line of data to generate the entire spreadsheet. The results section contains data determined by taking the differences between a proposed and the current plan and selecting the appropriate factors from the information section. These results are displayed in levels of aggregation varying from total savings to savings by PSP and geographic area.

2.3. User Interface

The guidance for the user interface was succinct. It had to be intuitive so that a budget analyst with only minimal knowledge of computers could work through an iteration. Written instructions had to be kept to a minimum so that analysts would be undaunted by complex instructions. And, finally, it had to be able to operate on different computer platforms as analysts have access to both PCs running DOS and Macintosh computers.

As a result of these requirements, The Meta-Model uses Excel as its main spreadsheet program. Excel was selected over Quattro or 1-2-3 both for the point and click way that users make selections and for the ease of programming the dialog boxes. Similar dialog boxes are used along each path to minimize the learning curve and, as stated earlier, the process mimics the procedure used by analysts making a budget estimate. The User's Manual, which can be found in Appendix B, is separated into two parts. The installation guide is one page long and can be discarded after the model is operational. The User's Guide is two pages long, but could be shortened by deleting sample dialog boxes. The Macro code for both Macintosh and PC computers can be found in Appendix C and dialog boxes are shown in Appendix D.

2.4. Improved Cost Factors

ABO's prime task is monitoring current expenditures. They have neither the time nor the resources to build predictive models. However, they are often tasked to provide budget estimates to decision makers. In the past, acceptable answers were obtained by using simple cost factors, dividing the total OMA dollars spent by the Army by the total end strength for the year. The limitations to this approach were that it did not account for cost differences in different areas of the world and that all savings were attributed to P2 (Mission), the largest account. The method was quick, but did not have the capability to estimate costs by PSP or variation in cost factors by geographic area.

To overcome these limitations, we improved the cost factors by gathering three years of data, sorted by PSP and MACOM. We then normalized for inflation and Operation Desert Storm, divided by the troop strength in each MACOM, and averaged the resulting cost factors. The long-term goal of this project is to replace these cost factors with output from validated Army budget models¹, but using cost factors allowed us to get an accurate prototype to the product user.

2.4.1. Operations and Maintenance, Army

Historical budget data were obtained from the Pentagon's Decision Support System financial database. Queries were made to determine the amount of money spent in each PSP by Major Command (MACOM) for fiscal years 89-91. This was then normalized for inflation and Desert Storm expenses were removed from the FY91 data. Cost factors, in thousands of dollars per soldier, were computed and averaged for each of the geographic areas of interest. The results are listed in Table 2-1.

MACOM	P2	P12	P38	P39	P72	P81	P87	P95	P10
Europe	18.874	3.727	.034	.021	1.012		.232	.019	1.159
CONUS	12.202	3.461	.007	.105	.085	.036	.171	.039	.001
Korea	23.598	6.962	.035	.056	.1874		.274	.018	.376
Panama	28.24	5.072	.049	.106	.146		.186	.031	.471
Pacific	16.22	4.821		.02	.187	.05	.209	.041	.045

Table 2-1. Geographic Areas and Associated Cost Factors
in \$1,000's per soldier

It is recommended that the cost factors remain a three year moving average of actual expenses. This provides adequate accuracy for the budget office and is simple to update. One of the limitations inherent in the moving average is that migration of funds from one PSP to another is not fully realized for three years. As an example, you will remember that beginning with FY92, much of what had been classified as P73 (Maintenance) is now P2 (Mission) money. Any FY92 predictions will then overestimate the amount spent on P73 and underestimate P2 by a corresponding amount. This discrepancy will decrease each year as cost factors with this change are included in the model and old ones are discarded. This

¹Cost factors are an accepted method of making budget predictions in the Army. Most MACOMs have their own cost factors handbook, an example of which is the Training and Doctrine Command's "Resource Factor Handbook", published annually. Like the costing models, the level of detail is much greater than that required by the Budget Office.

change will be fully realized at the beginning of FY95 using a three year moving average. If necessary, data from prior years can be normalized to reflect this change.

2.4.2. Military Pay and Family Housing

One advantage of Pro Forma's structure is its flexibility to include new information. Other PSPs, MACOMS, and appropriations can be easily added to the model. This became necessary during field testing of Pro Forma when the need arose to integrate Military Pay, Army (MPA) and Army Family Housing, Operations (AFHO) into the model. This was done in a matter of hours.

Cost factors were determined as before, except that the time period used was FY88-FY90, alleviating the need to account for Desert Storm. Obtaining AFHO cost factors was a straight forward proposition. Getting MPA cost factors, on the other hand, proved somewhat more complex.

AFHO is different than the OMA sub-programs already investigated in that its cost is not always incremental. It is assumed that family housing costs are incremental in Germany, Panama, Korea, and the Pacific because troops will abandon their quarters as they leave these areas. Thus, the costs can be treated in the same manner as the OMA costs. Housing in CONUS, on the other hand, is not incremental. Soldiers are required to live on post if housing is available. Therefore, as the number of troops decreases, AFHO costs will remain constant unless posts are closed. A cost factor for CONUS AFHO was determined, but it was not used.

MPA was further divided into MPA and Permanent Change of Station (PCS) accounts. Two assumptions were made and verified by the Office of the Deputy Chief of Staff for Personnel, ODCSPER that assisted in constructing the MPA cost factors. First, approximately 48% of the soldiers in the Army are married and second, about 90% of the married troops in Germany live in post housing.¹

MPA costs were not available by command, as they are accounted for in the ODCSPER budget and available only Army-wide. Several steps went into computing the cost factors for MPA (Table 2-2). First, total MPA costs for each year were obtained from historical data. Second, the following extracted to meet ABO's demands: PCS, Officer Basic Allowance for Quarters (BAQ), Officer Variable Housing Allowance (VHA), Enlisted BAQ and Enlisted VHA. PCS expenses were included as a separate line in the model and assumes the Army will continue its policy of rotating troops every four years. This is by no means certain, but it is an adequate starting point.

MACOM	MPA	PCS	AFHO
Europe	35.492	1.551	3.061
CONUS	35.496	1.551	0
Korea	35.498	1.551	0.801
Panama	35.492	1.551	3.327
Pacific	35.492	1.551	7.034

¹This information was given to me by MAJ Thomas Roberts, Army Budget Office. He received it in a phone conversation with a member of the DCSPER staff.

Table 2-2. Geographic Areas and MPA/AFHO Cost Factors
in \$1,000's per soldier.

Using the assumption that most troops in Germany live in quarters and extrapolating that to include Panama and the Pacific, no BAQ/VHA costs are associated with these areas. The assumed married rate of 48% was used to determine the allocation of BAQ/VHA costs between CONUS and Korea.

2.5. Sample Session

This section will lead the reader through a Pro Forma session.

2.5.1. Structuring the Force

The user starts Pro Forma by double clicking on the "Macro1" icon. This brings up the first dialog box:

- How do you want to structure the force?
1. Change the End Strength
 2. Change the End Strength by Changing One Geographic Area
 3. Change One Geographic Area and Maintain a Constant End Strength

Each of these options invokes different sub-routines on the Macro sheet.

1. Change the End Strength

Selecting this option enables the user to change each of the geographic areas while changing the total end strength. Changes to each geographic area are made proportionally to the current plan.

2. Change the End Strength by Changing One Geographic Area

Choosing this option brings up another dialog box:

- Which Area do You Want to Change?
1. Europe
 2. CONUS
 3. Korea
 4. Panama
 5. Pacific

This option permits the user to see the impact of changing the end strength by making changes to only one geographic area.

3. Change One Area while Maintaining a Constant End Strength

Choosing this option brings up the following dialog box:

Which Area do You Want to Change?

1. Europe
2. CONUS
3. Korea
4. Panama
5. Pacific

How do you want to re-apportion them?

1. Send all to CONUS?
2. Distribute them among the remaining Geographic Areas in the same proportion as the Current Proposal?

2.5.2. The Proposed Plan

Before Pro Forma prompts users for input, the Macro opens Pro Forma and saves it as a temporary file, preventing the user from inadvertently changing the base model. This process takes about one minute, although it can take significantly longer if many temporary files are open at the same time and competing for limited RAM.

Users are then presented a dialog box asking for their proposal. As an aid to the planner, the current proposal is listed as a default setting. Users must input end strengths for the years 1991 through 2000 for their particular plan. If needed, changes are made to the geographic areas in the same proportion as in the current plan.

2.5.3. Dialog Box for Further Options

After the computations are complete, a dialog box appears telling the user what to do when he is finished examining the current iteration.

Invoking the call for more options provides the following dialog box:

Do you want to

1. Save this option?
2. Print this option?
3. Do another iteration?

Options 1 asks the user for a document name and a directory in which to store it. Option 2 is self-explanatory Option 3 brings the user back to Section 2.5.1, Structuring the Force and begins the cycle anew.

2.5.4. Print Options and Sample Output

Three print options are available in Pro Forma, although the entire spreadsheet can be viewed. These are:

1. Print the Totals
2. Print the Totals and Geographic Area Roll-up
3. Print the Totals and the PSPs by Geographic Area

Appendix E contains output from three different force structure plans printed with option 1. The first shows the impact of reaching a final end strength of 535,500 one year early. The second shows the fiscal impact of a final end strength of 400,000. The third shows the impact of reducing the European end strength by 42,000 and placing them in CONUS.

The output can be viewed as three distinct sections: Personnel, Total Savings, and Savings by Area and PSP.

The Personnel section is further divided into: Proposed Troop Strength Plan, Current Troop Strength Plan and the Delta between the two. One line of user input generates the Proposed Plan and, thus, the entire spreadsheet. This is compared to the Current Plan, which is based on the submitted budget POM, and the Delta between the two is computed. Savings are a function of the Delta and the appropriate cost factors.

The Total Savings section provides savings by appropriation and by OMA PSP. Savings are listed in the years in which they occur. These fields are computed by summing up the appropriate areas on the sheet below as are the geographic areas.

The reader will notice that the OMA Savings and Geographic Area Savings appear as a series of steps. This is because savings as a result of troop reductions are not fully realized in the year of the reduction. The current algorithm calls for one-eighth of the savings to occur in the first year, one-half in the second, and three-eighths in the third. The correct algorithm is subject to debate, but can be easily integrated into Pro Forma once it is determined. The savings drag can be spread over six years without requiring major changes to the model. Further, Pro Forma has the built-in capability to drag fixed and variable costs at different rates for different lengths of time once these are identified.

2.6. Verification and Validation

In order for a model to be useful, it must address the proper questions, work as designed, and produce results that reflect those found in the real world. The Army's process of validation and verification seeks to address these two areas before a model can be widely used. Validation is the process of determining the extent to which models and simulations accurately represent the real-world from the perspective of the intended use of the model.

Verification determines that the models and simulations accurately represent the developer's conceptual description and specifications.¹

2.6.1. Verification

Care was taken to capture the main expenses and codify their relationship to end strength. In the case of Army Family Housing, it was decided to ignore any savings owing to troop reductions in CONUS as incremental changes in troop strength have little or no bearing on AFH operations. Other appropriations received similar scrutiny. Although large portions of the budget, specifically P72 and P73, are unaccounted for in the model, these are not thought to be as dependent on end strength as P2, P12, or MPA. Accounting for these expenses remains a goal of this project, but the rapid prototype approach demanded that we remain focused on P2.

Considerable time was spent on designing the user interface to ensure that it would address the needs of the user. We spent several hours exploring the user's normal procedure for framing budgetary questions and structuring the interface in a way that makes sense to the user. It is hoped that Pro Forma will meet with better success than previous automation efforts because it is both user friendly and it addresses questions from the analyst's perspective.

2.6.2. Validation

We tested results from the model against actual historical expenditures to ensure that Pro Forma accurately reflected the real world. First, we tested our results for P2 and P12 against actual expenditures for FY91 to see if we met our goal of capturing most of the P2 expenditures and to see how much P12 we got as a secondary effect of concentrating on the troop commands (Figures 2-3 and 2-4). This was done by comparing Pro Forma results against total OMA spent in FY91.

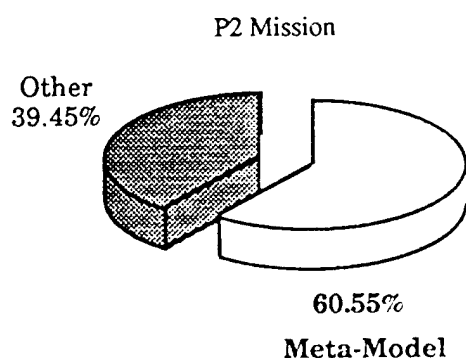


Figure 2-3. Percentage of P2 Accounted for in the Meta-Model

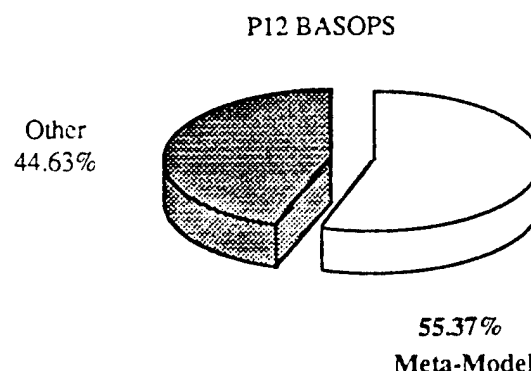


Figure 2-4. Percentage of P12 Accounted for in the Meta-Model

We then tested to see how accurately the Meta-Model estimated OMA expenditures by PSP in the five MACOMs (Table 2-3).

¹These definitions are taken from Army Regulation 5-11 (Draft), Deputy Undersecretary of the Army for Operations Research, 10 December 1991.

Pro Forma also performed well when placed against one of the Army's Costing Models -- The Army Force Structure Costing model, TAFSC. TAFSC attempts to capture P2 and P12 expenditures through detailed data entry. The user may request costing data for units ranging in size from company to division and get the data as it pertains to different locations. While it is possible to place units at specific posts in CONUS or Germany, TAFSC also provides a composite listing for these locations. As it was not possible to get budgetary data for a specific unit, the two corps in Germany were assembled from the units in the TAFSC database and located at a USAREUR Composite post. The estimate was made for FY90, prior to Desert Storm and the European draw-down and compared to actual expenditures. TAFSC underestimated P2 expenses by 20% and overestimated P12 expenses by 80%. Pro Forma, on the other hand, underestimated P2 by 7.5% and overestimated P12 by 3.8%.¹

Table 2-2 gives detailed results for FY91, expressed as the percentage of actual expenditures predicted by Pro Forma. The total predicted was 105.6% of the actual expenses which is well within ABO's requirements.

MACOMPSP	10	12	20	38	39	72	81	87	95
FORSCOM	219.0	92.8	141.6	100.4	39.9	95.0	5400	111.7	40.6
USAREUR	100.0	102.2	110.4	70.7	55.5	120.9		107.3	93.9
Korea	96.0	95.6	97.9	88.7	33.3	98.8		107.7	58.8
Pacific	120.0	71.8	74.2		293.8	151.4	453.1	85.4	42.9
Panama	104.0	70.7	122.8	71.4	1.5	138.1		98.5	72.4
TOTAL Prediction 105.6% of actual OMA expenditures.									

Table 2-3. Percentage of actual expenditures predicted by Pro Forma for FY91.

P10 and P81 are minor expenses in these MACOMs, thus small differences in expenditures translated into large percentage errors. Most of these large errors can be attributed to planned expenses that were not made as a result of Desert Storm.

¹P2 expenditures were \$2.65 billion vice \$2.45 billion predicted. P12 expenses were \$694 million vice \$721 million predicted.

3. Future Efforts

There are three topics of interest in continuing this project; improved OMA modeling, validating and integrating results from existing Army costing models, and integrating other appropriations.

Pro Forma set out to capture P2 and P12 expenditures and has met the sponsor's requirements. However, the project was never envisioned to end here. We now need to determine how much of OMA we had captured and decide where to concentrate our efforts for next year (Figure 3-1). We had captured the largest piece of the OMA pie, about 27%, with the Meta-Model. The two other large pieces, AMC and Finance Command (FINCOM), account for 20% and 22% of OMA respectively. Besides depot-level repairs, AMC is also responsible for overland transportation of items in the United States. FINCOM's big expense is trans-oceanic transportation of material. Further investigation revealed that FINCOM's FY91 expenditures were an anomaly due to the shipment of goods and equipment in support of Desert Storm. It also appears that a large portion of FINCOM's increase came at the expense of AMC as their combined share of the budget has been relatively constant during the past four years.

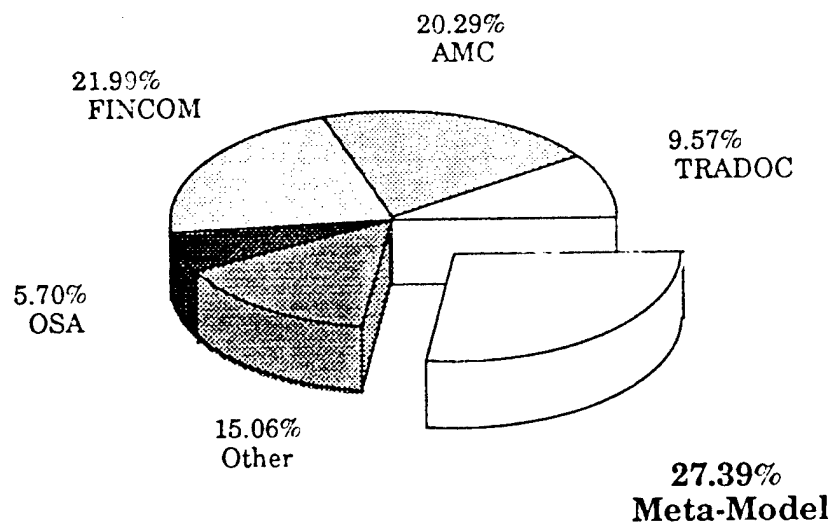


Figure 3-1. OMA Expenditures by MACOM

Looking closer at AMC's expenditures (Figure 3-2), we discovered that the largest remaining OMA PSPs are P72 (Supply) and P73 (Maintenance). These expenses are different than what has been previously modeled in that not only is there an operating cost associated with the size of the force, there is a cost associated with changing its size. The former can be approached the same way as the other OMA expenses were, by using a three-year moving average and adjusting for inflation. Some attempt will have to be made at accounting for the change of depot maintenance from AMC to using units, but this will hopefully be a minor inconvenience. Accomplishing the latter is a different story. The modeler will have to be concerned with the flow of the equipment from active components to the National Guard and Reserves to final disposition, the amount of repair that AMC must provide, and shipping costs. It is anticipated that a production cost function will be used to estimate costs after this information is determined.

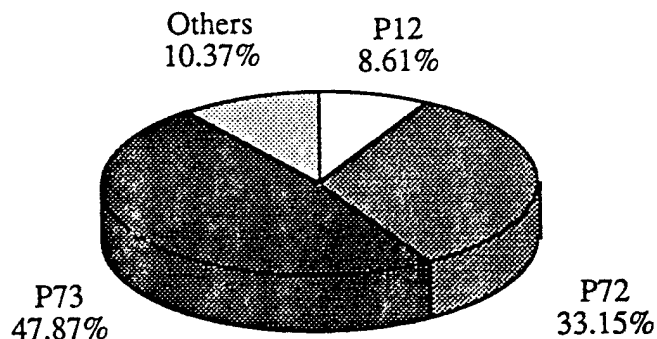


Figure 3-2. AMC's OMA Expenditures

Integrating results of existing Army models into the Meta-Model remains a goal of this project. Army agencies have spent a lot of time, effort, and money developing models to predict expenses and we would not be taking full advantage of the information available to the Budget Office if we did not exploit these models. Even though TAFSC did not provide useable results, attempting to integrate them still provided useful information. As a result, the Budget Office is aware of the model's shortcomings and can take them into account when presented with information derived from the model.

PMSDA is upgrading all of its models to work in a windows environment so that they are easier to use. They will still provide much more detail than required by the Budget Office but their results will be suitable for inclusion into Pro Forma. Two models currently available are the Non-Tactical Medical Support Model (NTMSM) and the Depot Maintenance Predictive Model (DMPM). Medical expenses are no longer the responsibility of the Army, and so NTMSM will not be of use. DMPM, on the other hand, may provide the information necessary to model P73 (Maintenance) and will be explored concurrently with other AMC modeling efforts.

Finally, other appropriations need to be integrated into Pro Forma. Initial efforts have already been made in this area with the inclusion of MPA and Army Family Housing. These, however, are rough estimates, and more work needs to be done to make sure that they are accurate. Research, Development, Test and Evaluation (RDT&E) funds also need to be investigated. RDT&E is a discretionary fund which is not necessarily tied to the size of the force. Further, it probably has an impact on procurement, and thus, on OMA in future years.

Finally, some minor work needs to be done on the user interface. Specifically, installation onto the analyst's hard drive could be made easier, especially for the DOS version. Microsoft says that the newly released Excel 4.0 for Windows has a "Clipper"¹-like utility that allows the spreadsheet to be made into an executable file. If true, this would facilitate installation and use of the model.

¹Clipper is a computer program that makes dBase files executable programs that no longer require dBase be loaded onto the user's computer. Information from Microsoft was received in a phone conversation with a sales representative on their toll-free number.

4. References

1. Sage, Andrew P., Decision Support Systems Engineering, John Wiley and Sons, Inc., New York, New York, 1991.
2. Model Architecture, Program Integration Analysis, Prepared by CACI, Inc.-Federal for Program Management Systems Development Agency, 1989.
3. Courtois, Peter N., "Force Structure Costing Model", Report Number 91-4, October 1991, Department of Systems Engineering, West Point, N.Y. 10996.
4. Army Command and Management: Theory and Practice, US Army War College, 1989-1990, Army Planning, Programming, Budgeting and Execution System, Pages 14-15.
5. Resource Factor Handbook, TRADOC Resource and Analysis Directorate, July 1991.
6. The Army Budget (Amended) Fiscal Years 1990 - 1991, Assistant Secretary of the Army for Financial Management, May 1989.

Appendix A. Army Models

The following table contains existing Army costing models, a brief explanation of programs covered, and other information. This information is extracted from "Model Architecture, Program Integration Analysis," for Program Management and Systems Development Agency, by CACI-Federal, Resource and Systems Analysis Group.

Nomenclature	Description	Comments
Individual Training Predictive Model	Estimates resource requirements for TRADOC missions of training, training development, training support and ROTC	Predicts cost by training center.
Battalion Level Training Model	Links training resource requirements for Army units to reach specified levels of training readiness.	Sustainment training only.
Training Resource Model	Uses BLTM output to develop organizational costs associated with achieving a proposed training strategy over an eight year period.	
Flying Hour Management System	Calculates the cost of flying hours per year. Identifies the hours required to reach a specific readiness level and the flying hours for a specified piece of equipment.	
Logistical Decision Support System	Separate modules for Maintenance, Equipment, Force structure, Non-Tactical Vehicles, POL/Water and Budget	
Status Projection System	Modules for Resource Allocation, Equipment, Personnel, and Training.	Uses LOGDSS and TRM as input.
BASOPs Predictive Model	Very detailed output based on 3 years data.	
Modernization, Sustainment, Developmental, & Operational Model	Costs for fielding and sustaining a given force structure.	
Force Resourcing Methodology	Predicts costs involved with modernizing the force. Includes procurement and Operating and Sustainment costs	Uses TRM, ITPM, MSDOM
Depot Maintenance Model	Relates supply management data to OPTEMPO (Operations Tempo) of the units involved. Enables OPTEMPO and equipment densities to be varied	
Non-Tactical Medical Support Model	Predicts requirements for medical costs, to include CHAMPUS, PRIMUS. Medical costs are now paid for by DoD and not of current interest.	
Integrated Planning Model	Computes resources required to support a projected force structure across a thirty year horizon.	Uses TRM, NTMSM,
Army Manpower Costing System	Life cycle cost model of Active, reserve, and civilian and produces a time phased profile of the cost of manpower over the life of a given weapon system or unit.	

Appendix B. User's Manual

B.1. Installation

Installing Pro Forma should be a simple task. Pro Forma may be placed into folders/directories other than the given ones, difficulties will be minimized by following the enclosed instructions.

B.1.A. Macintosh Installation

Check to see which version of Excel is on your hard drive. It should be either 2.2 or 3.0. Do this by clicking once on the Excel icon and then choosing File-Get Info from the Desktop menu bar.

Create the folder "Force Costing" on your desktop. Do this by choosing File-New Folder from the desktop's menu bar and then name the folder.

Insert the Pro Forma disk into your disk drive. You will see two folders on the disk: Excel 2.2 and Excel 3.0. Each contains the files "User" and "Macro1". Open the folder that corresponds to your version of Excel. Copy its contents into your newly-created folder "Force Costing". Drag only the folder's contents. Do not copy the entire folder into your new folder.

Start the program by double-clicking on "Macro1". Macro1 will take you through some additional steps if you used other folder names or placed the Force Costing folder inside another folder.

B.1.B. Windows Installation

Find the Excel directory on your hard drive. Make the new directory "Costing" inside it. Place the Pro Forma disk into your disk drive and copy the files to the new directory. This can be done either from the C:> prompt or from the File Manager.

To place a Costing icon on your windows desktop, do the following.

Determine which Program Group you want to place the icon in. Make it the active Program Group by single-clicking on one file in the group.

Select File-New from the menu bar and double-click on the File button.

Place the name of your icon in the Description block.

Place the following in the Command Line entry:

```
c:\windows\excel\costing\macro1.xls
```

Make sure that you have the proper path to Excel and Macro1 before you click on OK.

Quit Windows and Save the changes. Restart Windows by typing "win" at the C:\ prompt. Double click on your newly-made icon. The program may take you through some extra steps, especially if your path is set up different than the default path.

B.2. User's Guide

This bring up the first dialog box gives you the following choices:

How do you want to structure the force?

1. Change the End Strength
2. Change the End Strength by Changing One Geographic Area
3. Change One Geographic Area and Maintain a Constant End Strength

Option 1 enables the user to simultaneously change each geographic area by changing the total end strength. Changes to each area are made proportionally to the current plan.

Option 2 brings up another dialog box:

Which Area do You Want to Change?

Europe
CONUS
Korea
Panama
Pacific

This option permits the user to see the impact of changing the end strength by by making changes to only one geographic area.

Option 3 asks for some additional information.

How do you want to re-apportion the troops?

Send all to CONUS?
Distribute them among the remaining
Geographic Areas in the same proportion as
the Current Proposal?

Before users are asked for detailed input, the Pro Forma spreadsheet is saved as a temporary file, preventing the user from inadvertently changing it. This process takes about one minute, but it can take significantly longer if many temporary sheets are open at the same time and vying for limited RAM.

Users are then given a dialog box asking for their proposal. As an aid to the planner, the current proposal is listed as a default setting. Users must input end strengths for the years 1991 through 2000 for their particular plan. If needed, changes are made to the geographic areas in the same proportion as in the current plan.

After the computations are complete, a dialog box appears telling the user what to do when he is finished examining the current iteration.

Invoking the call for more options provides the following dialog box:

Do you want to	
1.	Save this option?
2.	Print this option?
3.	Do another iteration?

Options 1 asks the user for a document name and a directory in which to store it. The current directory is the default directory. Option 3 brings the user back to Section 3.4.1, Structuring the Force and begins the cycle anew.

The three print options are:

1. Print the Totals	
2. Print the Totals and Geographic Area	Roll-up
3. Print the Totals and the PSPs by Geographic Area	

Option 1 is normally all that is needed. Option 3 will print almost 20 pages, so do not select this unless you are certain that you want it.

Appendix C. Macro Program

This appendix provides the code for Macro1 should you decide to compose it yourself.

C.1. Auto_Open and option to change one Area but Maintain a Constant End Strength

This section provides instructions upon opening the macro. It also has some administrative data such as file names and paths for the macro and main spreadsheet file. It also calls the first dialog box and branches out to specific parts of the macro sheet. This portion of the macro sheet continues to be used if Option Three is chosen from the first dialog box.

The cell range for this function is A1:B160.

Auto_Open (o)
MacinStor™ 120:ORCEN:Force Costing:Spreadsheets

This is the default directory.
"HardDrive:Folder1:Folder2:etc"
If this is not a valid directory,
the macro prompts you for
your current directory and
updates itself.
This is the Macro name.
This is the current
worksheet name.

Macro1
TMP393_
TMP289_T

=ECHO(FALSE)
=DIRECTORY(A2)
=ERROR(TRUE,O14)
=ACTIVATE(A8)
i=COLUMNS(FILE\$)
dir=FALSE
=FOR("counter",1,i,1)
=IF(INDEX(FILE\$,counter)="User")
dir=TRUE
=GOTO(A23)
=ELSE()
=END.IF()
=NEXT()
=IF(dir=FALSE,GOTO(O2),GOTO(A26))
=ERROR(TRUE)
=DIALOG.BOX(Dialog_Box_1)
=IF(A27=FALSE)
=RETURN()
=ELSE.IF(I3=1)
=GOTO(K2)
=ELSE.IF(I3=2)
=GOTO(M2)
=ELSE()
=DIALOG.BOX(Dialog_Box_4)
=END.IF()

=IF(A35=FALSE,GOTO(A26),GOTO(A39))

=LEFT(RIGHT(NOW(),7),3)
=ACTIVATE(A8)

Opens Dialog Box 1 and
asks for input on how to
structure the force.

Branches to different cells
based on response in
Dialog Box 1.

Keeps user from overwriting

=SELECT(\$A\$9) =FORMULA("TMP"&A40&"_") =OPEN("User") =SAVE.AS(A9) =PROTECT.DOCUMENT?(FALSE,FALSE,FALSE)	main spreadsheet. Saves as a Temporary file.
=SELECT(!\$B\$30:\$K\$35) =CLEAR()	Clears formulae from proposal.
=SELECT(!CurrTot) =COPY() =SELECT(!TOTALRamp) =PASTE.SPECIAL(3,1,FALSE,FALSE)	Copies End Strength to proposal.
=IF(\$I\$59=1) =SELECT(!CurrEur) =COPY() =SELECT(!EuropeRamp) =ELSE.IF(\$I\$59=2) =SELECT(!CurrCON) =COPY() =SELECT(!CONUSRamp) =ELSE.IF(\$I\$59=3) =SELECT(!CurrKor) =COPY() =SELECT(!KoreaRamp) =ELSE.IF(\$I\$59=4) =SELECT(!CurrPan) =COPY() =SELECT(!PanamaRamp) =ELSE.IF(\$I\$59=5) =SELECT(!CurrPac) =COPY() =SELECT(!PacificRamp) =END.IF()	Selects Current Plan and places in dialog box for new ramps. Selects input area on current spreadsheet.
=ACTIVATE(A8) =SELECT(Ramps) =PASTE.SPECIAL(3,1,FALSE,TRUE)	Pastes current Plan to Macro.
=DIALOG.BOX(Dialog_Box_2) =IF(\$M\$46=FALSE) =GOTO(A35)	Requests troop strength.
=ELSE() =ACTIVATE(\$A\$8) =SELECT(Ramps) =COPY() =ACTIVATE(\$A\$9) =PASTE.SPECIAL(3,1,FALSE,TRUE)	Pastes data on proper line.
=SELECT("R[24]C:R[24]C[9]") =COPY() =SELECT("R36C2:R36C11") =PASTE.SPECIAL(3,1,FALSE,FALSE) =SELECT("R37C2:R37C11") =FORMULA("=R[-7]C-sum(R[-6]C:R[-1]C)")	Pastes delta for future operations. Pastes New Ramp.


```
=FILL.RIGHT()
=COPY()
=PASTE.SPECIAL(3,1,FALSE,FALSE)
=END.IF()
```

From I75

```
=SELECT(!$B$30)
=IF(I66=1)
=FOR("counter",1,5,1)
=SELECT("R[1]C:R[1]C[9]")
```

Skips this iteration.

```
=IF(counter=I59)
=GOTO(A119)
=ELSE.IF(counter=2)
=FORMULA("=R[12]C+R[4]C")
=FILL.RIGHT()
```

Pastes CONUS data.

```
=ELSE()
=FORMULA("=R[12]C")
=FILL.RIGHT()
```

Pastes Other Data

```
=END.IF()
```

From A102

```
=NEXT()
=SELECT(!$B$30:$K$35)
=COPY()
=PASTE.SPECIAL(3,1,FALSE,FALSE)
=SELECT(!$B$36:$K$37)
=CLEAR()
```

Clears unneeded information.

```
=ELSE()
=FOR("counter",1,5,1)
=SELECT("R[1]C:R[1]C[9]")
=IF(counter=I59)
=GOTO(A148)
=ELSE.IF(counter=1)
=FORMULA("=R[12]C+R[5]C*(R[12]C/R[6]C)")
=FILL.RIGHT()
=ELSE.IF(counter=2)
=FORMULA("=R[12]C+R[4]C*(R[12]C/R[5]C)")
=FILL.RIGHT()
=ELSE.IF(counter=3)
=FORMULA("=R[12]C+R[3]C*(R[12]C/R[4]C)")
=FILL.RIGHT()
=ELSE.IF(counter=4)
=FORMULA("=R[12]C+R[2]C*(R[12]C/R[3]C)")
=FILL.RIGHT()
=ELSE.IF(counter=5)
=FORMULA("=R[12]C+R[1]C*(R[12]C/R[2]C)")
=FILL.RIGHT()
=END.IF()
```

From A128

From A126

```
=NEXT()
=SELECT(!$B$30:$K$35)
=COPY()
=PASTE.SPECIAL(3,1,FALSE,FALSE)
=SELECT(!$B$36:$K$37)
=CLEAR()
=END.IF()
```

Clears unneeded information.

From A198

```
=SELECT(!$B$30)
=VLINE(-1)
=DIALOG.BOX(Dialog_Box_5)
=RETURN()
```

Gives instructions to continue.

C.2. Maintain a Constant End Strength

The range of this portion of the spreadsheet is K1:L32. It is called when the user wants to change the total end strength.

Total End Strength (t)

```
=ECHO(FALSE)
=DIRECTORY(A2)

=LEFT(RIGHT(NOW(),7),3)
=ACTIVATE(A8)
=SELECT($A$9)
=FORMULA("TMP"&$K$6&"_")
=OPEN("User")
=SAVE.AS(A9)
=PROTECT.DOCUMENT?(FALSE,FALSE,,FALSE)
=SELECT(!CurrTot)
=COPY()
=ACTIVATE(A8)
=SELECT(Ramps)
=PASTE.SPECIAL(3,1,FALSE,TRUE)
=DIALOG.BOX(Dialog_Box_2)
=IF(K18=FALSE,GOTO(K20),GOTO(K23))

=CLOSE(FALSE)
=RETURN()

=ACTIVATE(A8)
=SELECT(Ramps)
=COPY()
=ACTIVATE(A9)
=SELECT(!TOTALRamp)
=PASTE.SPECIAL(3,1,FALSE,TRUE)

=DIALOG.BOX(Dialog_Box_5)
=RETURN()
```

Turns off screen.

Sets directory to working
directory.
("DriveName:Folder1:Folder2")

Keeps user from overwriting
main spreadsheet.

Calls Dialog Box 2 or quits
Requests ramp strength by FY.

Closes User if you do not
want to proceed.

Takes data from Dialog Box 2
and puts it on spreadsheet.

C.3. Change the End Strength by Changing one Area

The range of this portion of the spreadsheet is M1:N69.

One Area (a)	
=ECHO(FALSE)	Turns off screen.
=DIRECTORY(A2)	Sets directory to working directory as listed in cell A2.
=LEFT(RIGHT(NOW(),7),3)	Provides names for worksheet and temporary file.
=ACTIVATE(A8)	
=SELECT(A9)	
=FORMULA("TMP"&SMS6&"_")	
=SELECT(A10)	
=FORMULA("TMP"&SMS6&"_T")	
=OPEN("User")	Keeps user from overwriting main spreadsheet.
=SAVE.AS(A9)	
=PROTECT.DOCUMENT?(FALSE,FALSE,,FALSE)	
=DIALOG.BOX(Dialog_Box_3)	Requests the area to change.
=IF(M17=FALSE)	
=GOTO(A26)	
=ELSE.IF(I43=1)	Europe
=SELECT(!CurrEur)	
=COPY()	Pastes current Plan to Macro.
=SELECT(!EuropeRamp)	
=ELSE.IF(I43=2)	CONUS
=SELECT(!CurrCON)	
=COPY()	Pastes current Plan to Macro.
=SELECT(!CONUSRamp)	
=ELSE.IF(I43=3)	Korea
=SELECT(!CurrKor)	
=COPY()	Pastes current Plan to Macro.
=SELECT(!KoreaRamp)	
=ELSE.IF(I43=4)	Panama
=SELECT(!CurrPan)	
=COPY()	Pastes current Plan to Macro.
=SELECT(!PanamaRamp)	
=ELSE.IF(I43=5)	Pacific
=SELECT(!CurrPac)	
=COPY()	Pastes current Plan to Macro.
=SELECT(!PacificRamp)	
=END.IF()	
=ACTIVATE(A8)	
=SELECT(Ramps)	Pastes current Plan to Macro.
=PASTE.SPECIAL(3,1,FALSE,TRUE)	

=DIALOG.BOX(Dialog_Box_2)	Requests troop strength.
=IF(\$MS46=FALSE)	
=GOTO(M16)	
=ELSE()	
=ACTIVATE(\$A\$8)	
=SELECT(Ramps)	
=COPY()	
=ACTIVATE(\$A\$9)	
=PASTE.SPECIAL(3,1,FALSE,TRUE)	Pastes data on proper line.
=SELECT(!Print_Totals)	
=COPY()	
=PASTE.SPECIAL(3,1,FALSE,FALSE)	
=SELECT(!A103:R829)	
=ERROR(FALSE)	
=CLEAR(1)	
=ERROR(TRUE)	
=VLINE(-65)	
=SELECT(!A26)	
=DIALOG.BOX(Dialog_Box_5)	
=END.IF()	
=RETURN()	

C.4. Error Checking for Filename and Path

The range of this spreadsheet is O1:P22.

=ALERT("Find and open the file ""User"". It should be in the same folder as the one you used to start this program.",2)	This subroutine interactively has the user input his working directory, saves it, and continues to run the macro.
=OPEN?()	
=ACTIVATE(A8)	
=DIRECTORY()	
=SELECT(O5)	
=COPY()	
=SELECT(A2)	
=PASTE.SPECIAL(3,1,FALSE,FALSE)	
=ACTIVATE("User")	
=CLOSE(FALSE)	
=GOTO(A16)	
=INPUT("The name of the file has been changed. Please enter the name of the file",2,,A8)	Same as above, except this is for the file name.
=IF(O15=FALSE,RETURN(),GOTO(O17))	
=SELECT(O15)	

```
=COPY()
=SELECT(A8)
=PASTE.SPECIAL(3,,FALSE,FALSE)
=GOTO(A10)
```

C.5. Additional Options, Print and Save

The range of this portion of the spreadsheet is K34:L77

Record4 (p)

=ECHO(FALSE)	
=DIALOG.BOX(Dialog_Box_6)	
=IF(K36=FALSE,RETURN(),GOTO(K38))	
=IF(I84=1)	Do another iteration?
=GOTO(A1)	
=ELSE.IF(I84=2)	Print?
=GOTO(K46)	
=ELSE.IF(I84=3)	Save this document?
=SAVE.AS?()	
=END.IF()	From K38
=RETURN()	
=IF(I3=2)	Does Printing Box
=PRINT(1,,,1,FALSE,FALSE,1,FALSE,1)	Prints Area Sheet.
=ELSE()	Provides Printing Options
=DIALOG.BOX(Dialog_Box_8)	for big spreadsheets.
=IF(I102=1)	Skips printing.
=RETURN()	
=ELSE.IF(IS102=2)	Prints totals.
=SELECT(!Print_Totals)	
=SET.PRINT.AREA()	
=PRINT(1,,,1,FALSE,FALSE,1,FALSE,1)	
=ELSE.IF(IS102=3)	Prints totals and Geographic
=SELECT(!Print_Tot_Geog)	Areas.
=SET.PRINT.AREA()	
=PRINT(1,,,1,FALSE,FALSE,1,FALSE,1)	
=ELSE.IF(IS102=4)	Prints totals and Sub-
=SELECT(!Print_Totals)	Programs.
=SET.PRINT.AREA()	
=PRINT(1,,,1,FALSE,FALSE,1,FALSE,1)	
=SELECT(!PSP_Print)	
=SET.PRINT.AREA()	
=PRINT(1,,,1,FALSE,FALSE,1,FALSE,1)	
=END.IF()	Ends printing options. From k52

=END.IF0

Ends Printing Block, from k46

=RETURN()

C.6. Dialog Boxes

5	9	5		180	Introduction		
14	9	15	400	100	How do you want to structure the force?		
11						1	
12	13	35	395		Change the End Strength		
12	13	55	395		Change the E/S by Changing One Geographic Area		
12	13	75	395		Change One Area but Maintain		
5	50	90			Constant End Strength		
1	120	145	64		OK		
2	245	145	64		Cancel		
					Dialog Box 1		
					Dialog Box 2		
5	9	9		390	Enter Ramp in 000's		
5	5	10			Use TAB to move between years.		
5	10	40			1991		
5	10	70			1992		
5	10	100			1993		
5	10	130			1994		
5	10	160			1995		
5	10	190			1996		
5	10	220			1997		
5	10	250			1998		
5	10	280			1999		
5	10	310			2000		
8	65	40	171			710.2	
8	65	70	171			640.2	
8	65	100	171			598.2	
8	65	130	171			556.7	
8	64	160	171			535.5	
8	65	190	171			535.5	
8	65	220	171			535.5	
8	65	250	171			535.5	
8	65	280	171			535.5	
8	65	310	171			535.5	
1	70	350	65		OK		
2	159	350	64		Cancel		

					Dialog Box 3		
5	9	9	240	200	Select the area to alter		
14	15	10	200	137	Select One		
11						1	
12					Europe		
12					CONUS		
12					Korea		
12					Panama		
12					Pacific		
1	35	165	64		OK		
2	125	165	64		Cancel		
					Dialog Box 4		
5	9	9			Decrement One Area		
5	9	10			You have elected to change one geographic		
5	9	25			area while maintaining the end strength		
5	9	40			at the current planned levels.		
14	9	70	320	110	Which area do you want to decrement?		
11						1	
12			280		Europe		
12			280		CONUS		
12			280		Korea		
12			280		Panama		
12			280		Pacific		
14	8	223	320	108	How do you want the reduction allocated?		
11						1	
12			280		All to CONUS		
12			280		Proportionally among the remaining		
5	63	279			Areas		
1	57	364	64		OK		
2	162	363	64		Cancel		
					Dialog Box 5		
5	9	9		140	When You're Finished		
5	9	15			Type ⌘-OPT-P to:		
5	68	35			Print		
5	67	55			Save		
5	67	75			Make another estimate		
1	80	105			OK		
					Dialog Box 6		
5	9	9			Options		
14	10	10	200	137	Select One		

11						1	
12	20	120	200		Do Another Iteration?		
12	20	80	200		Print This Document?		
12	20	40	200		Save This Document?		
1	40	170	64		OK		
2	130	170	64		Cancel		
					Dialog Box 7		
					No Longer Needed		
					Dialog Box 8		
5	9	9			Print Options		
5	12	15			The Proposed Plan, Current Plan,		
5	28	30			and Delta will be included in		
5	28	45			any printout.		
14	20	70	270	110	Options		
11						2	
12		90	250		None		
12		110	250		Totals Only		
12		130	250		Totals and Geographic Areas		
12		150	250		Totals and Sub-Programs		
1	40	190	64		OK		
2	130	190	64		Cancel		

C.7. Auto Close

The range of this macro is A163:B191.

Auto Close Del (d)

=DIRECTORY(A2)

=ECHO(FALSE)

i=1

=WHILE(COLUMNS(DOCUMENTS())>1)

=ACTIVATE(INDEX(DOCUMENTS(),i))

=IF(INDEX(DOCUMENTS(),i)=A8)

i=i+1

=SAVE()

=ELSE.IF(LEFT(INDEX(DOCUMENTS(),i),3)="TMP")

=CLOSE(FALSE)

=ELSE()

=CLOSE(TRUE)

=END.IF()

counter

Do the following when there is more than one open file.

Do not save TMP files.

Save other files.

=NEXT()	Ends WHILE loop.
i=1	
=WHILE(ISERROR(INDEX(FILE\$,i))=FALSE)	Gets rid of TMP files.
=IF(INDEX(FILE\$,i)=A8)	
i=i+1	
=GOTO(A189)	
=ELSE.IF(LEFT(INDEX(FILE\$,i),3)="TMP")	
=FILE.DELETE(INDEX(FILE\$,i))	
=ELSE()	
i=i+1	
=END.IF()	
=NEXT()	
=RETURN()	

C.8. DOS Differences

The following entries are the only differences between the Macintosh and DOS versions of the Pro Forma Macro.

Auto Open

The cell range for this entry is A1:B10.

Auto_Open (o)	
C:\WINDOWS\EXCEL\COSTING	This is the default directory. "HardDrive:Folder1:Folder2:etc"
	If this is not a valid directory, the macro prompts you for your current directory and updates itself.
Macro1.xls	This is the Macro name.
TMP298_.xls	This is the current
TMP143_T.xls	worksheet name.

Maintain a Constant End Strength.

The range for this entry is K1:L10.

Total End Strength (t)	
=ECHO(FALSE)	Turns off screen.
=DIRECTORY(A2)	Sets directory to working directory. ("DriveName:Folder1:Folder2")
=LEFT(RIGHT(NOW(),7),3)	
=ACTIVATE(A8)	
=SELECT(SA\$9)	
=FORMULA("TMP"&SK\$6&"_xls")	Keeps user from overwriting

=OPEN("User.xls")

Change the End Strength by Changing One Area

The range of this entry is M1:N13.

One Area (a)	
=ECHO(FALSE)	Turns off screen.
=DIRECTORY(A2)	Sets directory to working directory as listed in cell A2.
=LEFT(RIGHT(NOW(),7),3)	
=ACTIVATE(A8)	
=SELECT(A9)	
=FORMULA("TMP"&SMS6&"_xls")	Keeps user from overwriting
=SELECT(A10)	
=FORMULA("TMP"&SMS6&"_T.xls")	Creates Temp Filename.
=OPEN("User.xls")	
=SAVE.AS(A9)	main spreadsheet.

Error Checking for Filename and Path

The range of this entry is O1:P22.

=ALERT("Find and open the file ""User.xls."" It should be in the same directory as the one you used to start this program.",2)	This subroutine interactively has the user
=OPEN?()	has the user input his
=ACTIVATE(A8)	working directory, saves it,
=DIRECTORY()	and continues to run the
=SELECT(O5)	macro.
=COPY()	
=SELECT(A2)	
=PASTE.SPECIAL(3,1,FALSE,FALSE)	
=ACTIVATE("User.xls")	
=CLOSE(FALSE)	
=GOTO(A16)	
=INPUT("The name of the file has been changed. Please enter the name of the file",2,,A8)	Same as above, except this
=IF(O15=FALSE,RETURN(),GOTO(O17))	is for the file name.
=SELECT(O15)	
=COPY()	
=SELECT(A8)	
=PASTE.SPECIAL(3,,FALSE,FALSE)	
=GOTO(A10)	

Appendix D. Dialog Boxes

The following are representations of the dialog boxes shown to the analysts during a session with the Pro Forma. They are not exact, but they are very close.

Introduction

How do you want to structure the Force?

- ☐ Change the End Strength
- ☐ Change the End Strength by changing one area
- ☐ Change one area but maintain a constant End Strength

OK Cancel

Figure D-1. Introductory dialog box that the analyst sees when first starting Pro Forma.

Decrement one Area

Which area do you want to change?

- ☐ Europe
- ☐ CONUS
- ☐ Korea
- ☐ Panama
- ☐ Pacific

Where do you want to place them?

- ☐ All in CONUS
- ☐ Apportion them among the remaining geographic areas

OK Cancel

Figure D-2. Dialog box the analyst gets when choosing to keep the end strength constant but make changes in one area. The dialog box for Option 2 is the same as the top portion of this one.

Enter the Ramp in 000's

Tab to move between years

1991	<input type="text"/>
1992	<input type="text"/>
1993	<input type="text"/>
1994	<input type="text"/>
1995	<input type="text"/>
1996	<input type="text"/>
1997	<input type="text"/>
1998	<input type="text"/>
1999	<input type="text"/>
2000	<input type="text"/>

OK Cancel

Figure D-3. Prompt to input End Strength.

When You're Finished

Type - OPT - P to:

- Print
- Save
- Make another estimate

OK

Figure D-4. Instructions on how to continue.

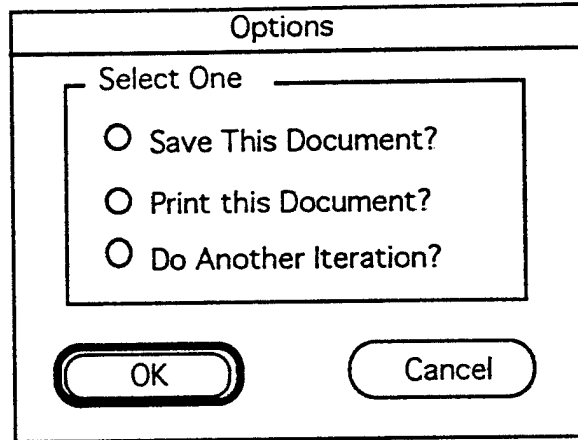


Figure D-5. Next dialog box in the sequence.

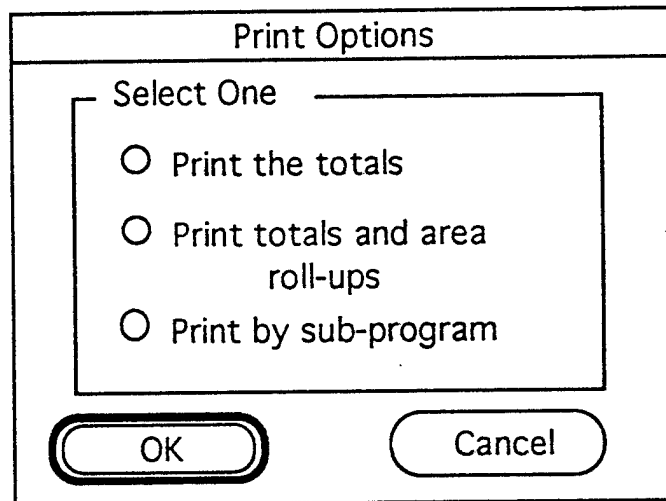


Figure D-6. Print option dialog box.

Appendix E. Sample Output

This section presents output from three different iterations of Pro Forma. The first represents reaching the final End Strength of 535,500 one year early. The second shows the results of changing the final Army End Strength to 400,000, and the third shows the results of reducing Europe by 42,200 and placing them in CONUS.

These were printed with Print Option 1, "Print the Totals".

Proposed Troop Strength Plan

This shows the impact of reaching the final Army End Strength of 535,500 one year early.

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	535.50	535.50	535.50	535.50	535.50	535.50	535.50
Europe	201.20	128.70	92.20	88.69	92.20	92.20	92.20	92.20	92.20	92.20
CONUS	451.39	453.89	448.39	391.39	385.69	385.69	385.69	385.69	385.69	385.69
Korea	25.56	25.56	25.56	24.59	25.56	25.56	25.56	25.56	25.56	25.56
Panama	7.50	7.50	7.50	7.21	7.50	7.50	7.50	7.50	7.50	7.50
Pacific	24.56	24.56	24.56	23.62	24.56	24.56	24.56	24.56	24.56	24.56

Current Troop Strength Plan

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	556.70	535.50	535.50	535.50	535.50	535.50	535.50
Europe	201.20	128.70	92.20	92.20	92.20	92.20	92.20	92.20	92.20	92.20
CONUS	451.39	453.89	448.39	406.89	385.69	385.69	385.69	385.69	385.69	385.69
Korea	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56
Panama	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Pacific	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56

Delta (000's of Troops)

Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL				21.20						
Europe				3.51						
CONUS				15.49						
Korea				0.97						
Panama				0.29						
Pacific				0.94						

Savings by Appropriation and Fiscal Year (Millions of Dollars)

Program	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL				451.14	564.11	112.97				
OMA				37.66	150.62	112.97				
MPA				376.25	376.25					
AFH				20.79	20.79					
PCS				16.44	16.44					

OMA Savings Stream into Outyears Total (Millions of Dollars)

Savings from cuts in FY:	Total for FY	1991	1992	1993	1994	1995	1996	1997	1998	1999
1991										
1992										
1993										
1994	301.25				37.66	150.62	112.97			
1995										
1996										
1997										
1998										
1999										
2000										
Total	301.25				37.66	150.62	112.97			

Savings by PSP and Fiscal Year **(Millions of Dollars)**

Savings in PSP	Total for PSP	1991	1992	1993	1994	1995	1996	1997	1998	1999
P2	204.78				25.60	102.39	76.79			
P39	1.80				0.23	0.90	0.68			
P72	5.27				0.66	2.63	1.97			
P81	0.60				0.08	0.30	0.23			
P87	3.98				0.50	1.99	1.49			
P95	0.74				0.09	0.37	0.28			
P10	4.63				0.58	2.31	1.74			
P12	79.45				9.93	39.72	29.79			
TOTAL					37.66	150.62	112.97			

Proposed Troop Strength Plan

This shows the impact of changing the final Army End Strength to 400,000.

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	556.70	500.00	400.00	400.00	400.00	400.00	400.00
Europe	201.20	128.70	92.20	92.20	86.09	68.87	68.87	68.87	68.87	68.87
CONUS	451.39	453.89	448.39	406.89	360.12	288.09	288.09	288.09	288.09	288.09
Korea	25.56	25.56	25.56	25.56	23.86	19.09	19.09	19.09	19.09	19.09
Panama	7.50	7.50	7.50	7.50	7.00	5.60	5.60	5.60	5.60	5.60
Pacific	24.56	24.56	24.56	24.56	22.93	18.34	18.34	18.34	18.34	18.34

Current Troop Strength Plan

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	556.70	535.50	535.50	535.50	535.50	535.50	535.50
Europe	201.20	128.70	92.20	92.20	92.20	92.20	92.20	92.20	92.20	92.20
CONUS	451.39	453.89	448.39	406.89	385.69	385.69	385.69	385.69	385.69	385.69
Korea	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56
Panama	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Pacific	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56

Delta (000's of Troops)

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL					35.50	135.50	135.50	135.50	135.50	135.50
Europe					6.11	23.33	23.33	23.33	23.33	23.33
CONUS					25.57	97.59	97.59	97.59	97.59	97.59
Korea					1.69	6.47	6.47	6.47	6.47	6.47
Panama					0.50	1.90	1.90	1.90	1.90	1.90
Pacific					1.63	6.21	6.21	6.21	6.21	6.21

Savings by Appropriation and Fiscal Year (Millions of Dollars)

Program	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL					756.16	3813.5	6612.5	7167.4	7224.5	7224.5
OMA					63.41	476.62	1324.1	1879.0	1936.2	1936.2
MPA					630.04	3034.8	4809.6	4809.6	4809.6	4809.6
AFH					35.17	169.43	268.51	268.51	268.51	268.51
PCS					27.54	132.64	210.21	210.21	210.21	210.21

OMA Savings Stream into Outyears Total (Millions of Dollars)

Savings from cuts in FY	Total for FY	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1991													
1992													
1993													
1994													
1995	507.28					63.41	253.64	190.23					
1996	1783.85						222.98	891.92	668.94				
1997	1936.24							242.03	968.12	726.09			
1998	1936.24								242.03	968.12	726.09		
1999	1936.24									242.03	968.12	726.09	
2000	1936.24										242.03	968.12	726.09
Total	10036.1					63.41	476.62	1324.8	1879.9	1936.4	1936.4	1694.1	726.09

Savings by PSP and Fiscal Year (Millions of Dollars)

Savings in Total for		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSP	PSP												
P2	6925.7					43.10	336.94	951.93	1316.2	1316.2	1316.2	1151.7	493.57
P39	60.12					0.37	2.92	8.26	11.42	11.42	11.42	10.00	4.28
P72	181.72					1.13	8.84	24.98	34.53	34.53	34.53	30.22	12.95
P81	20.12					0.13	0.98	2.77	3.82	3.82	3.82	3.35	1.43
P87	134.31					0.84	6.53	18.46	25.52	25.52	25.52	22.33	9.57
P95	24.62					0.15	1.20	3.38	4.68	4.68	4.68	4.09	1.75
P10	161.76					1.01	7.87	22.23	30.74	30.74	30.74	26.90	11.53
P12	2680.0					16.68	130.38	368.36	509.32	509.32	509.32	445.66	191.00
TOTAL						63.41	495.67	1400.3	1936.2	1936.2	1936.2	1694.2	726.09

E.3. Reducing Europe and Placing in CONUS

Proposed Troop Strength

This plan shows the impact of reducing European End Strength by 42,200 and placing them in CONUS.

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	556.70	535.50	535.50	535.50	535.50	535.50	535.50
Europe	201.20	128.70	92.20	50.00	50.00	50.00	50.00	50.00	50.00	50.00
CONUS	451.39	453.89	448.39	449.09	427.89	427.89	427.89	427.89	427.89	427.89
Korea	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56
Panama	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Pacific	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56

Current Troop Strength Plan

Geographic Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	710.20	640.20	598.20	556.70	535.50	535.50	535.50	535.50	535.50	535.50
Europe	201.20	128.70	92.20	92.20	92.20	92.20	92.20	92.20	92.20	92.20
CONUS	451.39	453.89	448.39	406.89	385.69	385.69	385.69	385.69	385.69	385.69
Korea	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56	25.56
Panama	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Pacific	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56	24.56

Delta (000's of Troops)

Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL										
Europe				42.20	42.20	42.20	42.20	42.20	42.20	42.20
CONUS				-42.20	-42.20	-42.20	-42.20	-42.20	-42.20	-42.20
Korea										
Panama										
Pacific										

(Millions of Dollars)

[illegible]

(Millions of Dollars)

Savings realized in FY

[illegible]

Savings by PSP and Fiscal Year (Millions of Dollars)

Savings Total for		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSP	PSP												
P2	1292.0				23.07	115.36	184.58	184.58	184.58	184.58	184.58	161.51	69.22
P39	-24.81				-0.44	-2.22	-3.54	-3.54	-3.54	-3.54	-3.54	-3.10	-1.33
P72	273.84				4.89	24.45	39.12	39.12	39.12	39.12	39.12	34.23	14.67
P81	-10.63				-0.19	-0.95	-1.52	-1.52	-1.52	-1.52	-1.52	-1.33	-0.57
P87	18.02				0.32	1.61	2.57	2.57	2.57	2.57	2.57	2.25	0.97
P95	-5.91				-0.11	-0.53	-0.84	-0.84	-0.84	-0.84	-0.84	-0.74	-0.32
P10	342.07				6.11	30.54	48.87	48.87	48.87	48.87	48.87	42.76	18.33
P12	78.58				1.40	7.02	11.23	11.23	11.23	11.23	11.23	9.82	4.21
TOTAL					35.06	175.29	280.46	280.46	280.46	280.46	280.46	245.40	105.17